A cytogenetic study of a hexaploid *Themeda triandra* Forssk. population

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Twenty-four *Themeda triandra* plants, collected from a population on a 20-m^2 plot in eastern Pretoria (Transvaal), were studied cytogenetically. All the plants were hexaploid ($2n$ = $6x$ = 60). From the meiotic chromosome associations it is concluded that the collected plants can be divided into two apomictic clones, of which the smaller one probably arose by sexual segregation from the larger one. The data support the fact that the hexaploids are near obligate apomicts.

Vier-en-twintig *Themeda triandra* plante is uit 'n bevolking op 'n 20-m^2 perseel in oostelike Pretoria (Transvaal) versamel en sitogeneties bestudeer. Al die plante was heksaploïed ($2n$ = $6x$ = 60). Van die meiotiese chromosoom-assosiasies kan afgelei word dat die plante aan twee apomiktiese klone behoort, waarvan die kleiner een waarskynlik deur geslagtelike segregasie uit die groter een ontstaan het. Die data ondersteun die feit dat die heksaploïede na aan verpligte apomikte is.

Keywords: *Themeda triandra*, polyploidy, microsporogenesis, meiosis.

Introduction

Various authors have reported on the distribution of populations with different ploidy levels in *Themeda triandra* (see Liebenberg 1986, 1990, for reviews of the literature). These studies reveal that the diploids tend to occur along the eastern and southern low-lying coastal regions of southern Africa, the hexaploids are concentrated on the Highveld, while the tetraploids and pentaploids tend to occur in the intermediate regions. No clear spatial or geographical demarcation between the different ploidy groups is evident, since the diploid, tetraploid and hexaploid populations often seem to occur in a close proximity, and sometimes overlap one another.

In an attempt to clarify this situation, Fossey and Liebenberg (1987) studied 28 plants of *T. triandra* from a population from Roodeplaat, just north of Pretoria. The collected plants were diploid or aneudiploid (16%).

In this communication we report on a further cytogenetic study on a population in the Faerie Glen area, south of the Magaliesberg. From the results of the previous surveys, it was predicted that this population would contain a high proportion of hexaploids, in spite of the fact that it is situated only about 20 km south of the diploid population at Roodeplaat.

Materials and Methods

Thirty-three plants (Fossey 1 – 33) were collected in an area of approximately 20 m^2 at Faerie Glen (25°46′S, 28°17′E), east of Pretoria. The plants collected were selected from a dense stand of *T. triandra* by means of a random walk through the plot and the use of random numbers to determine how many steps had to be taken between plants. Data on 24 of these plants, from which 25 metaphase I pollen mother cells (PMCs) could be cytogenetically analysed, are given in this report.

The young inflorescences were fixed in Pienaar's solution, 6:3:2 (methanol:chloroform:propionic acid) and squashed in 1% propionic carmine (Pienaar 1955).

Results and Discussion

The positions of the 33 plants relative to each other are given in Figure 1. The 24 plants studied cytogenetically were all hexaploid ($2n$ = $6x$ = 60), suggesting a wholly hexaploid population. The pairing analyses in the PMCs at metaphase I of these plants are presented in Table 1. All the plants have a fairly regular meiosis (Table 1) and the percentages of chromosomes bound as bivalents, vary between 99.1 and 99.6%.

The pairing associations of the PMCs analysed (Table 1) show that the 24 collected plants may be roughly divided into two groups: those with a high proportion of meiocytes

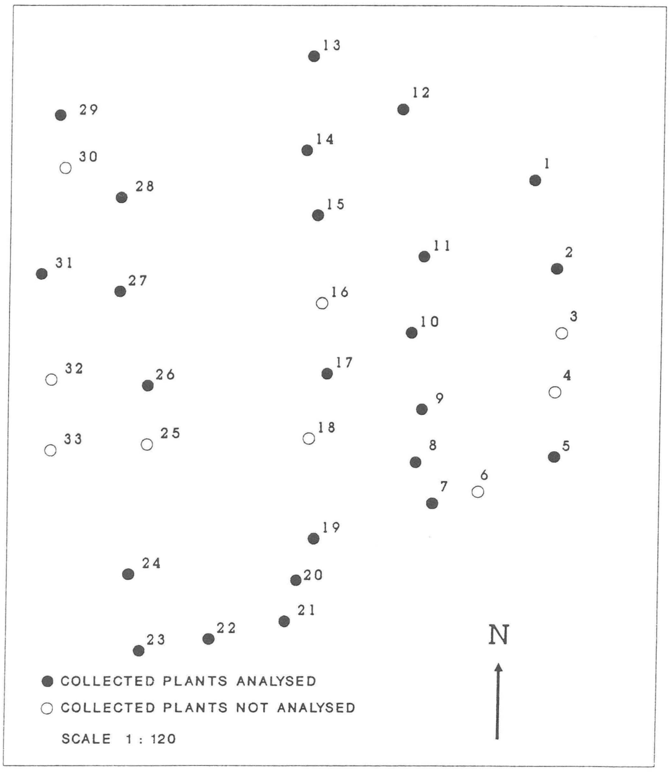

Figure 1 Relative plant positions (25°46′S, 28°17′E).

Table 1 Frequencies of metaphase I pairing associations in 24 collected plants

Metaphase I pairing associations	Percentage of PMCs at metaphase I in each pairing association class for each analysed plant																						
	1	2	5	7	8	9	10	11	12	13	14	15	17	19	20	21	22	23	24	26	27	28	29	31
30_{II}	76	72	84	80	80	72	88	72	84	68	56	48	80	88	88	72	84	68	80	44	80	52	76	76
$29_{II} + 2_I$	24	24	16	12	20	20	12	24	12	32	32	40	20	12	12	24	12	24	20	40	16	36	20	20
$28_{II} + 4_I$		4		4		8		4			8	4								16				4
$28_{II} + 1_{III} + 1_I$				4					4		4	4					4	8			4			
$27_{II} + 1_{III} + 3_I$												4												
$26_{II} + 2_{III} + 2_I$																4								
$26_{II} + 2_{IV}$																						8		
$26_{II} + 1_{III} + 5_I$																							4	
$25_{II} + 2_{IV} + 2_I$																						4		

(about 70 – 90%) with 30_{II} and a lower proportion of other pairing associations (Fossey 1, 2, 5, 7 – 13, 17, 19 – 24, 27, 29 & 31); and those in which only about 50% of the meiocytes have 30_{II} (Fossey 14, 15, 26 & 28). Within the first group, plants numbered Fossey 1, 2, 9, 11, 13, 21, 23, 29 & 31 have a slightly smaller proportion of PMCs with 30_{II} than in the other plants. This discrepancy may be due to the rather low number of cells analysed, and is probably not significant. The two major groups probably represent two apomictic clones which differ slightly from each other as far as their genetic constitution is concerned. It is noticeable that the four plants (Fossey 14, 15, 26 & 28) belonging to the second group were collected in close proximity to each other (Figure 1).

These differences do not reflect a different hybrid origin, but rather sexual segregation in otherwise apomictic plants. Liebenberg (1990) reported that a hexaploid from Pretoria possessed sexual embryo sacs in 8.7% of the ovules studied. Although all the ovules also contained aposporic embryo sacs, it is possible that these hexaploids will form a low proportion of seed with sexually derived embryos.

The high uniformity of the meiotic chromosome pairing associations support the fact that the hexaploids from the Faerie Glen area are near obligate apomicts. However, some sexually derived seed may nevertheless be formed which can give rise to plants with variant meiotic associations. This study has shown that a pairing association analysis can be a very useful tool in cytogenetic studies of agamic polyploid complexes to identify different apomictic clones. However, at least 50 PMCs per collected plant should be analysed to obtain more representative data.

From this and previous studies (Gluckmann 1951; De Wet 1960; Liebenberg 1986, 1990; Fossey & Liebenberg 1987), it is reasonable to assume that the Magaliesberg mountain range forms an east/west boundary between high polyploids (mainly hexaploids) and plants of lower ploidy levels (diploids and tetraploids). It is not clear why the Magaliesberg became a barrier or how it occurred. Little reliable information is available on the distribution of populations with different ploidy levels in the northern and central Transvaal. Such a study on *T. triandra* populations north and south of the Magaliesberg, just west of Pretoria, has been undertaken (Liebenberg, Fossey and Lubbinge, in preparation).

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